

OBITUARY

WALTER EMIL WESTMAN
(1945–1991)

The field of Mediterranean-ecosystem science lost a significant researcher, intellectual force, and personal friend with the untimely death of Walter Emil Westman on January 3, 1991. Walt died at the age of 45 from complications associated with AIDS. Over the two decades of his professional career, he made significant contributions to the fields of plant ecology, ecosystem science, and biogeography and environmental policy. He was the author of two books and nearly 100 articles over this too brief period. Among Mediterranean-ecosystem researchers, Walt is best known for his series of studies on coastal sage scrub communities in California and Baja California and on his work with plant community resilience to fire or pollutant stress. He was a leader in these studies in the application of multivariate approaches to understanding community level patterns. Equally significant, however, were his contributions in environmental policy and ecological impact research. His 1985 book, *Ecology, Impact Assessment, and Environmental Planning* was a pioneering and successful effort to integrate theoretical ecological principle with policy issues of environmental impact assessment and resource management.

Walt was born in New York City on November 5, 1945, and obtained his bachelor's degree in botany from Swarthmore College in 1966. He completed a master's degree in 1969 at Macquarie University in Australia, working with studies of the community ecology of eucalypt forests. This interest in quantitative approaches to community and ecosystem ecology led him to Cornell University where he completed his Ph.D. degree in 1971 working with the late R. H. Whittaker. His dissertation work on the structure and function of the pygmy forest ecosystem in the wet coastal forests of northwestern California have become a classic study on the edaphic control of ecosystem processes along catenas of soil change.

After completion of his Ph.D., Walt followed up his interest in applied ecology with a year in Washington, DC on a Congressional fellowship from the American Political Science Association. He served as a staff advisor to Senator Edward Muskie on the U.S. Senate Subcommittee on Air and Water Pollution, where he helped to write the important Federal Water Pollution Control Act of 1972. This experience was instrumental in developing his concepts of how science and public policy could be linked to bring a more quantitative approach to enlightened management of natural resources and realistic controls of air and water pollutants.

Walt returned to Australia for two years in 1972 where he was Lecturer in Ecology at the University of Queensland in Brisbane. This period was a productive one for research on biomass, productivity and nutrient cycling in subtropical eucalypt forests, with ten papers on this work published between 1975 and 1981. Walt returned to the U.S. in 1975 to take a faculty position at UCLA where he began his important work on coastal sage scrub ecosystems. In numerous publications, beginning in 1979 and continuing up to the present, he and his students developed a multi-disciplinary approach to vegetation sciences. This work ranged from biogeography, diversity and conservation biology to succession and community structure, to ecosystem stability and resilience in response, and to human impacts from fire and air pollution. Walt left UCLA in 1984, but continued an active interest in coastal sage scrub ecology. At the time of his death, he was staff scientist in Ecology and Environmental Policy at the Lawrence Berkeley Laboratory at the University of California, Berkeley.

Plant ecology was always a coequal interest with environmental policy for Walt Westman, and his contributions to this later field were particularly significant. Ecologists less familiar with this aspect of his career should look at not only his 1985 book, but a number of influential articles on this subject. Particularly notable are his "How much are Nature's services worth?" (*Science* 197:960–964, 1977), "Measuring the inertia and resilience of ecosystems" (*Bioscience* 28:705–710, 1978), "Managing for biodiversity: unresolved science and policy questions" (*Bioscience* 28:26–33, 1990),

and "Park management of exotic plant species: problems and issues" (Conservation Biology 3:251–260, 1990). With his remarkable level of energy, Walt freely gave his time to serve on advisory committees to numerous government agencies concerned with issues of environmental quality and resource utilization. These included the U.S. Senate Subcommittee on Environmental Pollution (1975–1976), the Global 2000 Study of the Council on Environmental Quality (1977–1978), the Commission on Ecology of the International Union for the Conservation of Nature and Natural Resources (1979–1991), the Ecosystem Effects Working Group of the EPA National Acid Deposition Assessment Program (chair 1985), and the Unmanaged Lands working Group of the United Nations Intergovernmental Panel on Climate Change (chair 1989–1991).

Beyond his scientific accomplishments, Walt was an accomplished classical violinist with training at the Julliard School of Music in New York City. Writing under a pseudonym, he had also published a number of short stories and poems. Social and ethical issues also formed an important part of Walt's life. In 1980, he became the founder and coordinator of the *National Organization of Gay and Lesbian Scientists and Technical Professionals*, and he was a participant in the *Gay and Lesbian History Project* in San Francisco. Until the time of his death, he was an active supporter of *Project Inform*, an advice and advocacy group for persons with AIDS.

Beyond the tangible scientific contributions made by Walt Westman during his life, his influence will be felt for many years through the career of the many students who worked with him during his years at UCLA. He was a stimulating and inspirational teacher, an interactive colleague, and a friend to many ecologists. His passing is especially untimely in light of the current Natural Community Conservation Planning process by the Resource Agency of California for the endangered sage scrub community—a process to which he would have contributed enormously. In 1981 he alerted ecologists to sage scrub's conservation crisis in his "Diversity relations and succession in Californian coastal scrub" (Ecology 62:170–184). His death is an irreplaceable loss to Mediterranean-ecosystem studies and the broader field of ecology as well.

PUBLICATIONS

Books

- WESTMAN, W. E. and W. D. CONN. 1976. Quantifying the benefits of pollution control: benefits of controlling air and water pollution from energy production and use. Energy Resources Conservation and Development Commission, State of California, Sacramento. 419 p.
- WESTMAN, W. E. 1985. Ecology, impact assessment, and environmental planning. (Environmental Science and Technology: A Wiley-Interscience Series of Texts and Monographs). Wiley-Interscience, New York. 535 p.

Articles, I: On plant ecology and remote sensing

- WESTMAN, W. E. 1968. Invasion of fir forest by sugar maple in Itasca Park, Minnesota. *Bulletin of the Torrey Botanical Club* 95:172–186.
- WESTMAN, W. E. and D. J. ANDERSON. 1970. Pattern analysis of sclerophyll trees aggregated to different degrees. *Australian Journal of Botany* 18:237–249.
- WESTMAN, W. E. 1971. Mathematical models of contagion and their relation to density and basal area sampling techniques. Pp. 515–536 in G. P. Patil, E. C. Pielou and W. E. Waters (eds.), *Statistical ecology 1: spatial patterns and statistical distributions*, Wiley, New York.
- LEWIN, D. C. and W. E. WESTMAN. 1973. Pattern diversity in a *Eucalyptus* forest. *Australian Journal of Botany* 21:247–251.
- WESTMAN, W. E. 1975. Edaphic climax pattern of the pygmy forest region of California. *Ecological Monographs* 45:109–135.

- WESTMAN, W. E. and R. H. WHITTAKER. 1975. Pygmy forest region of northern California: biomass and primary productivity. *Journal of Ecology* 63:493–520.
- THATCHER, A. C. and W. E. WESTMAN. 1975. Succession following mining on high dunes of coastal southeast Queensland. *In Proceedings of the Ecological Society of Australia* 9:17–33.
- WESTMAN, W. E. 1975. Pattern and diversity in swamp and dune vegetation, North Stradbroke Island. *Australian Journal of Botany* 23:339–354.
- WESTMAN, W. E., F. D. PANNETTA and T. STANLEY. 1975. Ecological studies on reproduction and establishment of the woody weed, Groundsel bush (*Baccharis halimifolia*) L.: Asteraceae). *Australian Journal of Agricultural Research* 26:855–870.
- WESTMAN, W. E. 1976. Vegetation conversion for fire control in Los Angeles. *Urban Ecology* 2:119–137.
- ROGERS, R. W. and W. E. WESTMAN. 1977. Seasonal nutrient dynamics of litter in a subtropical eucalypt forest, North Stradbroke Island. *Australian Journal of Botany* 25:47–58.
- WESTMAN, W. E. and R. W. ROGERS. 1977. Biomass and structure of a subtropical eucalypt forest, North Stradbroke Island. *Australian Journal of Botany* 25:171–191.
- WESTMAN, W. E. and R. W. ROGERS. 1977. Nutrient stocks in a subtropical eucalypt forest, N. Stradbroke Island. *Australian Journal of Ecology* 2:447–460.
- WESTMAN, W. E. 1978. Patterns of nutrient flow in the pygmy forest region of northern California. *Vegetatio* 36:1–17.
- WESTMAN, W. E. 1978. Inputs and cycling of mineral nutrients in a coastal subtropical eucalypt forest. *Journal of Ecology* 66:513–531.
- WESTMAN, W. E. 1978. Evidence for the distinct evolutionary origins of canopy and understorey in the *Eucalyptus* forest—health alliance of Australia. *Journal of Biogeography* 5:365–376.
- WESTMAN, W. E. 1978. Measuring the inertia and resilience of ecosystems. *BioScience* 28:705–710.
- WESTMAN, W. E. 1979. Californian coastal forest healths. Pp. 465–470 *in* R. L. Specht (ed.), *Ecosystems of the world. Heathlands and related shrublands*. Elsevier Science Publishers, Amsterdam.
- WESTMAN, W. E. 1979. A potential role of coastal sage scrub understories in the recovery of chaparral after fire. *Madroño* 26:64–68.
- ROGERS, R. W. and W. E. WESTMAN. 1979. Niche differentiation and maintenance of genetic identity in cohabiting *Eucalyptus* species. *Australian Journal of Ecology* 4:429–439.
- WESTMAN, W. E. 1979. Oxidant effects on Californian coastal sage scrub. *Science* 205:1001–1003.
- WESTMAN, W. E. 1980. Gaussian analysis: identifying environmental factors influencing bell-shaped species distributions. *Ecology* 61:733–739.
- WESTMAN, W. E. 1981. Diversity relations and succession in Californian coastal sage scrub. *Ecology* 62:170–184.
- WESTMAN, W. E. 1981. Factors influencing the distribution of species of Californian coastal sage scrub. *Ecology* 62:439–455.
- ROGERS, R. W. and W. E. WESTMAN. 1981. Growth rhythms and productivity of a coastal subtropical eucalypt forest. *Australian Journal of Ecology* 6:85–98.
- WESTMAN, W. E., J. F. O'LEARY and G. P. MALANSON. 1981. The effects of fire intensity, aspect and substrate on post-fire growth of Californian coastal sage scrub. Pp. 151–179 *in* N. S. Margaris and H. A. Mooney (eds.), *Components of productivity of Mediterranean regions—basic and applied aspects*. Tasks for Vegetation Science Series. Dr. W. Junk, The Hague.
- WESTMAN, W. E. 1981. Seasonal dimorphism of foliage in Californian coastal sage scrub. *Oecologia* 51:385–388.
- WESTMAN, W. E. and R. K. PEET. 1982. Robert H. Whittaker (1920–1980): the man

- and his work. *Vegetatio* 48:97–122. (Reprinted in Peet, R. K., ed. 1985. *Plant community ecology*. Dr. W. Junk, The Hague.)
- WESTMAN, W. E. 1982. Coastal sage scrub succession pp. 91–99. *In* Symposium on dynamics and management of mediterranean-type ecosystems. USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, General Technical Report PSW-58.
- WESTMAN, W. E. 1983. Xeric Mediterranean-type shrubland associations of Alta and Baja California and the community/continuum debate. *Vegetatio* 52:3–19. (Reprinted in Peet, R. K., ed. 1985. *Plant Community Ecology*. Dr. W. Junk, The Hague.)
- WESTMAN, W. E. 1983. Plant community structure—spatial partitioning of resources, pp. 417–445. *In* F. J. Kruger, D. T. Mitchell, and J. U. M. Jarvis (eds.), *Mediterranean-type ecosystems. The role of nutrients*. Ecological Studies 43. Springer-Verlag, Berlin.
- WESTMAN, W. E. 1983. Island biogeography: studies on the xeric shrublands of the inner Channel Islands, California. *Journal of Biogeography* 10:97–118.
- WESTMAN, W. E. 1983. (convenor), C. Boucher, B. M. Campbell, R. M. Cowling, B. Lamont, H. P. Linder, R. G. Noble, B. W. van Wilgen. The structure and dynamics of plant communities, pp. 77–90. *In* J. A. Day (ed.), *Mineral nutrients in Mediterranean ecosystems*. South African National Science Programmes Report 71, CSIR, Pretoria.
- MALANSON, G. P. and W. E. WESTMAN. 1985. Post-fire succession in Californian coastal sage scrub: the role of continual basal sprouting. *American Midland Naturalist* 113:309–318.
- WESTMAN, W. E., K. P. PRESTON and L. B. WEEKS. 1985. Sulfur dioxide effects on the growth of native plants, pp. 264–280. *In* W. E. Winner, H. A. Mooney, and R. Goldstein (eds.), *Sulfur dioxide and vegetation—physiology, ecology, and policy issues*. Stanford University Press, Stanford, California.
- WESTMAN, W. E. 1985. Air pollution injury to coastal sage scrub in the Santa Monica Mountains, southern California. *Water, Air, and Soil Pollution* 26:19–41.
- WESTMAN, W. E. and J. F. O'LEARY. 1986. Measures of resilience: the response of coastal sage scrub to fire. *Vegetatio* 65:179–189.
- WESTMAN, W. E. 1986. Pacific coastal shrublands of the U.S.–Mexico borderlands: characteristics and conservation challenges. *In* P. Ganster and H. Walter (eds.), *Proc. Intl. Symp. on Environmental Hazards and Bioresources of the United States–Mexico Borderlands*. UCLA Latin American Center, Los Angeles.
- WESTMAN, W. E. 1986. Resilience: concepts and measures, pp. 3–19. *In* B. Dell, A. J. M. Hopkins, and B. Lamont (eds.), *Resilience in Mediterranean-type ecosystems*. Tasks for Vegetation Science Series. Dr. W. Junk, The Hague.
- PETERSON, D. L., W. E. WESTMAN, N. L. STEPHENSON, V. G. AMBROSIA, J. A. BRASS, and M. A. SPANNER. 1986. Analysis of forest structure using thematic mapper data. *I.E.E.E. Transactions on Geoscience and Remote Sensing* GE-24:113–121.
- WESTMAN, W. E. 1987. Aboveground biomass, surface area, and production relations of red and white fir *Abies magnifica* and *A. concolor*. *Canadian Journal of Forest Research*: 17:311–319.
- WESTMAN, W. E. and J. A. PARIS. 1987. Detecting forest structure and biomass with C-band multipolarization radar: physical model and field tests. *Remote Sensing of Environment* 22:249–269.
- WESTMAN, W. E. 1987. Implications of ecological theory for rare plant conservation: the case of coastal sage scrub, pp. 133–140. *In* T. S. Elias (ed.), *Conservation and management of rare and endangered plants*. California Native Plant Society, Sacramento, California.
- WESTMAN, W. E. and C. V. PRICE. 1987. Remote detection of air pollution stress to vegetation: laboratory-level studies, pp. 451–456. *In* *Remote sensing: understanding the earth as a system*, Vol. I. Proc. 1987 IEEE Intl. Geoscience Remote Sens. Symp., Inst. Electrical & Electronic Engineers, New York, New York.
- PRICE, C. V. and W. E. WESTMAN. 1987. Vegetation mapping and stress detection

in the Santa Monica Mountains, California, pp. 1195–1200. *In* Remote sensing: understanding the earth as a system, Vol. II. IEEE International Geoscience Remote Sensing Symposium, Institute of Electrical & Electronic Engineers, New York.

- WESTMAN, W. E. 1987. Monitoring the environment by remote sensing. *Trends in Ecology and Evolution* 2:333–337.
- PRICE, C. V. and W. E. WESTMAN. 1987. Toward detecting California shrubland canopy chemistry with AIS data, pp. 91–99. *In* G. Vane (ed.), Proceedings of the 3rd Airborne Imaging Spectrometer Data Workshop. Jet Propulsion Laboratory, California Institute of Technology, and NASA, Pasadena, California. JPL Publ. 87-30.
- WESTMAN, W. E. and C. V. PRICE. 1988. Spectral changes in conifers subjected to air pollution and water stress: experimental studies. *IEEE Transactions of Geoscience and Remote Sensing* 26:11–21.
- WESTMAN, W. E., coord. 1988. Species richness, pp. 81–91 *In* R. L. Specht (ed.), Mediterranean-type ecosystems. Kluwer Academic Publishers, Amsterdam.
- O'LEARY, J. F. and W. E. WESTMAN. 1988. Regional disturbance effects on herb succession patterns in coastal sage scrub. *Journal of Biogeography* 15:775–786.
- WESTMAN, W. E. and C. V. PRICE. 1988. Detecting air pollution stress in southern California vegetation using LANDSAT Thematic Mapper band data. *Photogrammetric Engineering and Remote Sensing* 54:1305–1311.
- WESTMAN, W. E. and P. J. TEMPLE. 1989. Acid mist and ozone effects on leaf chemistry of two western conifer species. *Environmental Pollution* 57:9–26.
- WESTMAN, W. E., L. STRONG, and B. A. WILCOX. 1989. Tropical deforestation and species endangerment: the role of remote sensing. *Landscape Ecology*: 3:97–109.
- WESTMAN, W. E. 1989. Tropical deforestation and species endangerment: applications of remote sensing. *In* C. Elvidge (ed.), Image Processing '89. American Society of Photogrammetry and Remote Sensing, Falls Church, Virginia.
- WESTMAN, W. E. 1989. Detecting early signs of regional air pollution injury to coastal sage scrub. *In* G. M. Woodwell (ed.), The Earth in transition. Patterns and processes of biotic impoverishment. Cambridge University Press, New York.
- WESTMAN, W. E. and G. P. MALANSON 1990. Effects of climatic change on Mediterranean-type ecosystems in California and Baja California. *In* R. Peters (ed.), Consequences of the greenhouse effect for biological diversity. Yale University Press, New Haven.
- WESTMAN, W. E. 1990. Structural and floristic attributes of recolonizing species in large rainforest gaps. North Queensland. *Biotropica* 22:226–234.
- WESTMAN, W. E. 1991. Measuring realized niche spaces: climatic response of chaparral and coastal sage scrub. *Ecology* 72:1678–1684.
- MALANSON, G. P. and W. E. WESTMAN. 1991. Modeling interactive effects of climate change, air pollution, and fire on a California shrubland. *Climatic Change* 18: 363–376.
- MALANSON, G. P. and W. E. WESTMAN. 1991. Climate change and the modeling of fire effects in chaparral, pp. 91–96. *In* S. C. Nodvin and T. A. Waldrop (ed.), Fire and the environment: ecological and cultural perspectives. USDA Forest Service, General Technical Report SE-69.
- MALANSON, G. P., W. E. WESTMAN, and Y-L. YAN. 1992. Realized versus fundamental niche functions in a model of chaparral response to climatic change. *Ecological Modelling* 64:261–277.

Articles, II: On environmental science and public policy

- WESTMAN, W. E. 1972. Offshore development and environmental problems of the future. *Ecology Today* 2(2):11–13, 46, 48–49.
- WESTMAN, W. E. 1972. The Queensland Clean Waters Act, 1971: a critical review. *Operculum* 2(2):32–36.
- WESTMAN, W. E. 1972. Some basic issues in water pollution control legislation. *American Scientist* 60:767–773. (Reprinted in F. Horton and B. J. L. Berry (eds.),

- Urban environmental management: planning for pollution control. Prentice-Hall, Englewood Cliffs, NJ; and *Operculum* 3:99–105.)
- WESTMAN, W. E. 1972. The future for land disposal of water wastes. *Operculum* 2(3):73–80. (Reprinted in *Victoria's Resources* (July–Aug. 1973), and Australian Water Research Foundation Special Report [1973].)
- WESTMAN, W. E. and R. M. GIFFORD. 1973. Environmental impact: controlling the overall level. *Science* 181:819–825. (Reprinted in R. Kane and G. A. Wistreich, *Biology For Survival*. Glencoe Press, New York.)
- WESTMAN, W. E. 1973. Environmental impact statements: boon or burden? *Search* 4:465–470.
- WESTMAN, W. E. 1973. Queensland's clean water regulations. *Operculum* 3(3):3–5.
- WESTMAN, W. E., E. BOURNE, E. BESWICK, M. COLBO, and T. LAWSON. 1973. The use and effect of plant-hormone herbicides (2,4-D and 2,4,5-T) in Australia. *Operculum* 3:89–94.
- WESTMAN, W. E. 1974. Bioassays and biological monitoring, pp. 275–281. *In* B. Hart (ed.), *A compilation of Australian water quality criteria*. Australian Water Resources Council Technical Paper No. 7.
- WESTMAN, W. E. 1974. A new strategy for clean water. *Operculum* 4:27–33.
- WESTMAN, W. E. 1975. Ecology of canal estates. *Search* 6:491–497.
- WESTMAN, W. E. 1976. Rationing environmental impacts using a second currency. *Journal of Environmental Management* 4:355–381.
- WESTMAN, W. E. 1977. Problems in implementing U.S. water-quality goals. *American Scientist* 65:197–203. (Reprinted in B. J. Skinner (ed.), 1981. *Use and misuse of the Earth's surface*. Kaufmann, Los Altos. Pp. 111–117.)
- WESTMAN, W. E. 1977. How much are Nature's services worth? *Science* 197:960–964.
- WESTMAN, W. E. 1977. America's progress towards cleaner waters. *Operculum* 5:112–118.
- WESTMAN, W. E. 1980. Synthesis session: opening remarks and summary of panel/audience discussion, pp. 215–220. *In* P. R. Miller (ed.), *Effects of air pollutants on Mediterranean and temperate forest ecosystems*. USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, General Technical Report PSW-43.
- WESTMAN, W. E. 1982. Environment. Pp. 270–272 *in* *Science Year 1983*. World Book Childcraft International Inc., Chicago.
- WESTMAN, W. E. 1983. Environment. Pp. 270–273 *in* *Science Year 1984*. World Book Childcraft International Inc., Chicago.
- WESTMAN, W. E. 1984. Environment. *In* *Science Year 1985*. World Book Childcraft International Inc., Chicago.
- WESTMAN, W. E. 1985. Environment. Pp. 269–272 *in* *Science Year 1986*. World Book International Inc., Chicago.
- WESTMAN, W. E. 1985. Global pollution analysis and monitoring, pp. 185–188. *In* T. Parrish Snyder (ed), *The biosphere catalogue*. Synergetic Press, London.
- WESTMAN, W. E. 1986. Environment, pp. 260–263. *In* *Science Year 1987*. World Book International Inc., Chicago.
- WESTMAN, W. E. 1989. Evaluating the benefits of ecosystem integrity. *In* *Ecosystem integrity and surprise*. Great Lakes Fishery Commission/International Joint Commission.
- WESTMAN, W. E. 1990. Managing for biodiversity: unresolved science and policy questions. *BioScience* 40:26–33.
- WESTMAN, W. E. 1990. Park management of exotic plant species: problems and issues. *Conservation Biology* 3:251–260.

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